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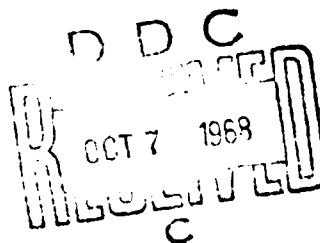
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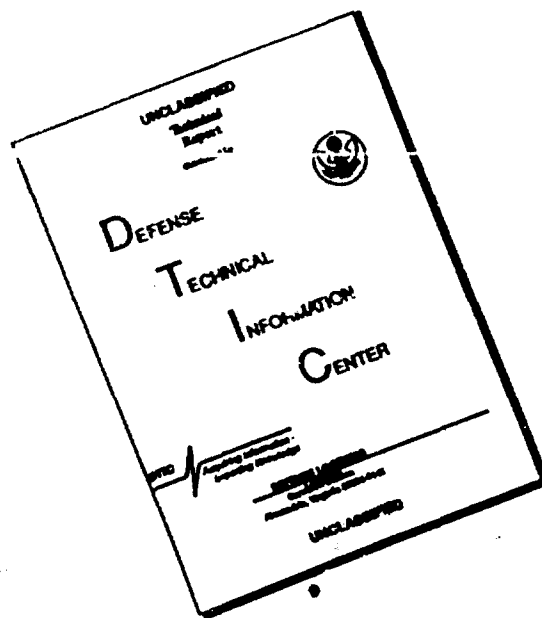
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MATERIALS ON THE NATURAL-SCIENCE PRINCIPLE FOR THE CLASSIFICATION OF  
INFECTIOUS DISEASES OF MAN

Following is the translation of an article by V. D. Belyakov, published in the Russian-language periodical Zhurnal Mikrobiologii, Epidemiologii i Immunobiologii (Journal of Microbiology, Epidemiology and Immunobiology) No 11, 1966, pages 131--136. It was submitted on 16 Nov 1965. Translation performed by Sp/7 Charles T. Ostertag, Jr.

The discovery by L. V. Gromashevskiy of the law of conformity between the mechanism of transmission of infectious disease causative agents and their main localization in the host organism is an important event in epidemiology. This is the starting point in an understanding of the natural historical development of infectious diseases and the basis of many aspects of their epidemiology and pathogenesis. At the same time, being guided by this criterion, it was possible for the first time to arrive at a scientific classification of all infectious diseases (of man, animals and plants).

At the present time this provision can be considered as generally acknowledged. Unfortunately, at the present time there still remain differences of opinion in its realization relative to the classification of infectious diseases of man. The disagreement seems to be in regard to two main questions. The first is connected with the primary criterion for the classification of infectious diseases of man: Initially should all the diseases be divided into anthroponoses and zoonoses and then utilize the classification principle of L. V. Gromashevskiy, or, just the opposite, initially separate the groups of disease according to the method of transmission (and the related localization of the causative agent in the organism), with the subsequent division of each group into anthroponoses and zoonoses. The second problem is in regards to the assignment of the separate zoonotic infections according to classification group.

There is still a third point of dispute. This is in regards to terminology - the designation of the individual groups of diseases (based on the mechanism of transmission or the localization of the causative agent). However, it is not principle, or decisive, since it is proposed that there exists an organic bond and interdependency between the mechanism of transmission and the localization of the causative agent. And if there were no infections of the leishmaniasis type, then this question might not have been raised.

These problems and concrete proposals for resolving them were stated by me in an article published in 1962. / Journal of Microbiology, Epidem-

iology and Immunobiology, 1962, No 5, p 126.<sup>7</sup> The suggestion was made for the primary division of all infectious diseases of man into anthroponoses and zoonoses, the designation of the groups of diseases based on the mechanism of transmission and not the localization of the causative agent, and finally note was made of the necessity for the subsequent utilization of the principle of natural-scientific classification (according to which the basic point is considered the natural mechanism of transmission and its related localization of the causative agent, as a result of which the latter exists as an organic species) in respect not only to anthroponoses, but also zoonoses.

Over the period which has elapsed these questions have been subjected to discussion. Attention is merited in particular to the works of N. I. Fedorova<sup>1</sup> and M. P. Kozlov<sup>2</sup>. /1. Journal of Microbiology, Epidemiology and Immunobiology, 1963, No 12, p 65; 2. Ibid., 1965, No 9, p 129. / The authors made an attempt to find a compromise (both different) solution for the second point of discord (placement of the individual zoonotic infections based on classification groups). As regards the primary criterion for classification, N. I. Fedorova substantiates the rightfulness of dividing all the infectious diseases of man initially into anthroponoses and zoonoses, and M. P. Kozlov - based on the feature of causative agent localization and its related mechanism of transmission. Thus, during the process of discussion the positions of the authors on the disputed questions did not come any closer, but differed more.

There is basis to consider that the existing differences in the particular approaches to the classification of infectious diseases of man in a general view of the main problem (acceptance as basic of the classification criterion of L. V. Gromashevskiy) are connected with two circumstances besides the others.

In the first place, L. V. Gromashevskiy worked out various aspects of the overall science dealing with the epidemic process. He started with an analysis of manifestations of the epidemic process, inherent primarily or exclusively to anthroponotic infections and extended the regularities formulated by him to zoonotic infections also. His proposed arrangement for the course of an epidemic process is considered as universal, though it reflects the peculiarities of this process for only one group of diseases - anthroponotic, caused unconditionally by pathogenic microorganisms. As a result an unique inertia was created, an unwillingness to take into consideration the data accumulated by that time, testifying to the qualitative originality of the epidemic process during zoonoses and anthroponoses. And if earlier the necessity for separating out the individual group of zoonoses was proven only empirically - by a certain community of practical measures in respect to this group of diseases in contrast to measures during anthroponoses, then now there are also theoretical bases, connected with the formation of the main scheme for the course of the epidemic process during zoonoses and by a number of common features and peculiarities in the epidem-

iology of all zoonotic infections regardless of the mechanism of transmission of the agents causing them (connection between the reservoir and animals, polypathogenicity, polytrophic nature, ability for infection by various routes, and others).

Some authors behave reservedly to the proposal to initially divide all infectious diseases into anthroponoses and zoonoses. This stems from misgivings about damaging the classification of L. V. Gromashevskiy. Correctly this is an unique argument which is cited by opponents to such an approach to classification. However, such apprehension may be caused by misunderstanding alone. The importance of the stated classification principle with such an approach is not only not lessened, but on the other hand it is stressed with greater force. This is confirmed by a closer analysis of the second circumstance, which should be taken into consideration when analyzing differences of opinion in connection with the natural-historical classification of infectious diseases of man.

Up until now sufficient consideration has not always been given to the evolution-biological conditionality between the mechanism of transmission of the causative agents and their primary localization in the organism of the host. This is manifested in the fact that an empirical approach is often taken to the separation of the mechanism of transmission and the localization of the causative agent which are inherent for this or that infection, based on the frequency of manifestation of a specific mechanism of transmission of an infectious onset (and localization) during human infections. In turn the scientific recognition of the bond and interdependency between the mechanism of transmission and localization of the causative agent as necessary logically assumes the separation from all of the possible ones of that mechanism and that localization due to which the causative agent exists as an organic species. These two features - frequency and biological necessity for the manifestation of this or that mechanism of transmission of the causative agent - conform naturally if an analysis is made of the infection of organisms which make up the reservoir for that causative agent. Therefore, when there is talk of anthroponoses, that is, diseases, the causative agent of which exists due to passaging among humans alone, the results of the empirical and the natural-historical approach to the distribution of diseases by groups correspond. In this case adherents of both approaches are satisfied and disputes do not arise.

Differences in results, depending on the empirical or natural-historical approach, are displayed in the classification of zoonoses, that is, infections in which the biological necessity of this or that mechanism of infection is realized in the world of specific species of animals, and the frequency of manifestation of one or the other mechanism is calculated under the conditions of human infection. The feature of biological necessity has been conditioned in an evolutionary sense by being established and developed over a period of many years, and consequently is stable. The feature of frequency of human infection is variable, depending on the changing conditions in

the bond between man and nature. Therefore these two features may not coincide during zoonoses, and if they do coincide then this is usually accidental and temporary.

If the variability in the frequency of manifestation for the various mechanisms of infection of humans with zoonoses is kept in mind, then when the empirical principle of classification in general is preserved it is not possible to arrive at a consistent opinion relative to the distribution of diseases by groups. Therefore there is still controversy as to whether brucellosis and leptospirosis should be regarded in the group of intestinal or contact infections (some authors under some conditions encounter it most often as an alimentary or aqueous infection, others under other conditions - as contact). With the empirical approach these disputes are not alleviated, but on the other hand are intensified, since the frequency for the manifestation of the mechanisms of human infection under changing conditions varies for a number of other zoonotic infections also. Tularemia, for example, is regarded in the group of vector (blood) infections, though infection by this mechanism takes place less often than by other mechanisms. Plague is also found in the group of vector infections, but over the entire period of plague pandemics a considerable volume of the cases was connected with the aerial-droplet transmission of the causative agent. At the present time an intestinal form of anthrax is encountered among the population of certain regions of Africa. It is the result of using raw animal meat as food. In Europe the cutaneous form of anthrax is encountered most often as a result of various types of contact by man with infected raw materials. And in the last century anthrax infection often took place by the aspiration route. However, it does not follow from this that in the classification of the last century anthrax should be found in the group of aerial-droplet infections, and in the modern classification for Africa - in the group of intestinal infections, and for Europe - in the group of contact infections. This list of perplexities and discrepancies could go on, but it has been stated sufficiently to be convincing that the exit from the blind alley is the replacement of the empirical approach in the realization of the principle of classification as scientific. It follows from what has been stated that in respect to zoonoses this replacement is more necessary than in respect to anthroponoses.

Consequently, recognition of the basic principle of classification is insufficient, a harmony in understanding this principle is required. The path to compatibility of positions lies through harmony in understanding. And the initial subdivision of diseases into anthroponoses and zoonoses not only does not interfere with the classification of L. V. Gromashevskiy, but is the only path to its subsequent realization. This furthers the universality of the stated principle, which was formulated by the author when analyzing anthroponoses and used unsuccessfully by him relative to zoonoses. However, with such a universalization it is assumed that during zoonoses it is necessary to take into consideration the passaging of the causative agents through the organism of those species of animals which represent the reservoir for these causative agents.

N. I. Fedorova and M. P. Kozlov consider that the subdivision of zoonotic infections based on the localization of the causative agent in the animal organism and the natural mechanism inherent to the epizootic process would depreciate the antiepidemic significance of classification (the mechanism by which man is infected often is not the same one by which the causative agent lives in nature). But, in the first place the talk is not about applied "antiepidemic" classification of infectious diseases. Relative to zoonoses for these purposes a natural-scientific classification cannot be formulated, but only a certain empirical arrangement which is not the same for various conditions. Secondly, a correct reflection of the natural-historical ties, established in nature, can still never lessen the achievements of practice, unless it simplifies the practical approach to the objective regularities of nature which have been revealed by man.

The final practical mission of epidemiology is the eradication of infections which are harmful or strongly affect man. The accomplishment of this mission presumes the eradication of the causative agent as an organic species, which is possible when consideration is given to the mechanism of transmission due to which the causative agent exists in nature. In the modern stage applicable to zoonoses, epidemiology is limited to solving the narrowest practical mission - to prevent human morbidity with these infections. This is achieved by making use of data on the mechanisms by which man is most frequently infected. Therefore, in the classification of diseases the attempt is often made to take into consideration primarily these mechanisms. But with a more detailed analysis of the essence of the problem one can be convinced that from the purely practical positions of today the antiepidemic significance of classification is reduced in the event we limit ourselves to an analysis of just the statistical data on the frequency with which man is infected in this or that manner. And not because, as was already pointed out above, this frequency is different under various conditions and reference to it is correctly oriented in one case and disoriented in another. It is more important that any practical measures are profitable if they are conducted on the basis of a knowledge of the natural history of the infection, and the latter is determined by its biological properties, the most significant of which is the mechanism of transmission of the causative agent which guarantees its existence in nature. Derivatives of this main biological property of the causative agent are those, due to which, under specific social relationships, the infection of man is observed most often. The antiepidemic practice wins only if practical measures are carried out, taking these theoretical interrelationships into consideration. Also no exception is the generally known provision that there is nothing more practical than the theory reflecting the objective bonds of phenomena.

The very raising of the question on the acceptability of carrying out antiepidemic measures on the basis of classification data merits attention. In practice nobody does this. It is necessary to give attention to the fact that knowledge of natural-historical classification alone is

not sufficient for the correct performance of measures under the concrete conditions of a focus. For this it is necessary to know the epidemiology of the particular infection. The results of such measures will be full-valued if, along with this, consideration is given to the taxonomic position of the infection in the series of other infectious diseases.

In this manner the expressed apprehensions in connection with the fact that the successive utilization of the natural-historical principle of classifying infectious diseases of man (in particular, zoonoses) may disorient the practical work cannot be accepted as valid. Nevertheless, they served as the grounds for other proposals on improving existing classifications. Thus, N. I. Fedorova suggests that the group of zoonotic infections with multiple mechanisms of distribution be distinguished. However, the very concept of zoonoses assumes the possibility of multiple mechanisms for spreading the causative agents, and therefore the stated proposal loses meaning.

It is important to stress the point that the indicated peculiarity of zoonoses is not accidental, it has been conditioned by evolution. In the dispersed settling of animals (in contrast to the communal form of life for man) with complex biocenotic ties in specific biotopes, the greatest chances of survival during the process of evolution were obtained by those variants of causative agents, which as a result of mutability, strengthened by heredity, adapted themselves to multiplication and spreading among several species of animals by various mechanisms of implantation. It is known that introduction of cholera vibrios into the blood or the plasmodia of malaria into the gastro-intestinal tract does not cause illness. The causative agents of the majority of zoonotic infections find conditions for multiplication by the most diverse mechanisms of implantation in an organism. This explains why man, under various conditions, is infected by the majority of zoonotic infections in different ways. If an attempt is made to consider all these circumstances, then, as it was already pointed out, in the best case it is possible to arrive at a more or less successful empirical arrangement, which by itself is useful and even necessary for individual aims and missions. Therefore the second proposal of N. I. Fedorova has been justified - to subdivide zoonoses "outside of the general classification" into separate groups, taking into consideration the various approaches (active and passive, synanthropic and xenanthropic, etc.). But such a principle is not acceptable when we are dealing with natural-historical classification. And it is mainly this with which we are dealing.

M. P. Kozlov made an attempt to combine the natural-historical approach and direct practical interests by presenting in the same table the main and supplementary mechanisms of human infection, characteristic for each infection. Without a doubt such an approach is of interest, particularly for educational purposes. However, even this table, just as any other, cannot be recommended as a guide in practical measures. It does not free the specialists from the necessity of studying the



epidemiology of concrete infections. All the more so one cannot accept this table as natural-historical classification. The latter should not be burdened with a large number of features and should answer the single fundamental question concerning the natural-historical place of the disease among others. The table of M. P. Kozlov can be viewed as a working superstructure toward natural-historical classification, but only in the event that it is constructed actually, not declaratively, on the evolution-adaptation principle: The primary division of infections into anthroponoses and zoonoses with the subsequent division of each group based on the feature of the basic, natural mechanism of transmission of the causative agent (considering that for zoonoses, relative to the mechanism of infecting man it may be only the most frequent one under certain conditions, but not the main mechanism).

In conclusion a few words on the particular problem, raised by N. I. Fedorova, concerning the place of Q-fever in the classification of zoonotic infections. It is generally accepted that foci of this disease are preserved due to the vector transmission of the causative agent. However, there is all the reason to assume that there exists the separate and independent circulation of *Rickettsia burneti* among domestic animals - small cattle and horned cattle. The interrelationships between the natural foci of infection and the zoonotic branch of domestic animals have still not been revealed. The mechanism of circulation of the causative agent among domestic animals has still not been studied. It can only be assumed that the vector transmission of this causative agent is a more atavistic feature than the main mechanism due to which the causative agent exists in nature. This is testified to be the astonishing stability of the causative agent in the external environment. This biological peculiarity has been acquired by *Rickettsia burneti* during the process of evolution, apparently not by vector, but by other mechanisms of circulation among animals, which stimulated the acquisition of this stability. Consequently additional knowledge is necessary for the final solving of the problem on the place of Q-fever in the classification of zoonoses. However, this cannot serve as the basis for revising the very principle of the classification of zoonotic infections. On the contrary rather, in this case support is again given to the practical value of theoretical generalization, which is the natural science classification of infectious diseases. It illuminates the path of knowledge for the investigator.